

EXECUTIVE SUMMARY

EEAP, NORFOLK DISTRICT

ABERDEEN PROVING GROUNDS, MARYLAND

BoILER/CHILLER






DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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FINAL REPORT
EXECUTIVE SUMMARY
EEAP, NORFOLK DISTRICT
ABERDEEN PROVING GROUNDS, MARYLAND

BOILER/CHILLER

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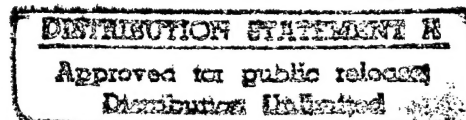
Department of the Army
Norfolk District, Corps of Engineers
Norfolk, Virginia 23510

Under Contract No. DACA-65-84-C-0105

November 1986



B. N. Gidwani, P.E.
Project Manager



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W.O. #0335-72-01

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SECTION 1

EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report presents the results of the Energy Engineering Analysis Program conducted by Roy F. Weston, Inc. at the Aberdeen and Edgewood Areas of Aberdeen Proving Grounds under Contract No. DACA-65-84-C-0105. The study includes evaluation of boiler and chiller plant performance by tests, identification and analysis of specific efficiency improvements, evaluation of existing equipment condition and maintenance procedures, and project development and documentation preparation.

The report consists of six volumes.- one set of three for the Aberdeen Area and one set of three for the Edgewood Area. Each set consists of:

- Volume I: Survey and Test Results
- Volume II: Evaluation of Energy Conservation Opportunities
- Volume III: Appendix

Volume I contains results of the field survey and tests performed on the boiler and chiller plants. The report evaluates the condition of existing equipment and highlights specific efficiency improvements. Volume II contains detailed calculations for the various energy conservation opportunities. Volume III contains the life cycle cost analysis for all applicable energy conservation opportunities.

1.2 HISTORICAL ENERGY CONSUMPTION

Table 1.1 and 1.2 summarizes the total annual fuel oil and electric consumption for Aberdeen and Edgewood for FY 1984. A total of 15,272,456 gallons of fuel oil and 141,463,804 kWh electricity were required from October 1983 to September 1984. Fuel oil consumption for FY84 was 10.75% higher than for FY83 and electric consumption was up 6.59% over FY83. Since this study is restricted to specific boiler and chiller plants as mentioned in the scope of work, it is helpful to summarize the annual fuel oil consumption in those specific boiler plants. Table 1.3 lists the annual fuel consumption for Aberdeen Area and Table 1.4 lists the same for the Edgewood Area. No electric metering was available for individual buildings.

1.3 FINDINGS

The work done was performed in two phases. The first phase involved site visits, data collection and performance tests on the boiler and chiller plants. Volume I summarizes these results. The second phase involved evaluation of various energy conservation opportunities (ECOs) and economic analysis.

TABLE 1.1
TOTAL FUEL OIL (GALLONS) CONSUMPTION FOR FY '84

	Aberdeen Area	Edgewood Area	Total
Oct 83	270,295	556,665	826,960
Nov 83	615,322	806,840	1,422,162
Dec 83	1,021,628	1,106,545	2,128,173
Jan 84	1,398,540	1,331,365	2,729,905
Feb 84	946,110	1,039,982	1,986,092
Mar 84	1,005,035	1,043,346	2,048,381
Apr 84	673,390	697,809	1,371,199
May 84	67,850	753,928	821,778
Jun 84	50,101	414,336	464,437
Jul 84	104,747	434,349	539,096
Aug 84	67,462	373,406	440,868
Sep 84	98,646	394,759	493,405
TOTAL	6,319,126	8,953,330	15,272,456

Cost of Fuel Oil = \$1.03/gallon

Source: Utilities Division, Mr. Larry Taylor

TABLE 1.2
TOTAL ELECTRICITY CONSUMPTION FOR FY '84

	Aberdeen Area		Edgewood Area		Total		Cost
	KWH	MBTU	KWH	MBTU	KWH	MBTU	
Oct 83	6,179,968	71,688	4,682,259	54,314	10,862,227	126,002	\$ 425,634
Nov 83	5,782,175	67,073	3,890,416	45,129	9,672,590	112,202	386,635
Dec 83	6,775,160	78,592	4,395,239	50,985	11,170,399	129,577	444,336
Jan 84	6,233,886	72,313	3,844,291	44,594	10,078,177	116,907	401,510
Feb 84	6,197,098	71,887	3,861,221	44,790	10,058,319	116,677	402,050
Mar 84	6,505,451	75,463	4,061,672	47,115	10,567,123	122,570	418,601
Apr 84	6,282,703	72,879	4,091,976	47,467	10,374,679	120,346	404,651
May 84	6,292,975	72,999	4,753,010	55,135	11,045,985	128,134	418,007
Jun 84	8,123,913	94,237	6,261,532	72,634	14,385,445	166,871	849,848
Jul 84	8,355,669	96,926	6,486,103	75,239	14,841,772	172,165	879,678
Aug 84	8,693,892	99,805	6,514,776	75,571	15,118,668	175,376	897,058
Sep 84	7,551,401	87,596	5,737,019	66,549	13,288,420	154,145	798,965
TOTAL	82,884,291	961,458	58,579,513	679,522	141,463,804	1,640,980	\$6,726,982

Source: Utilities Division, Mr. Larry Taylor

TABLE 1.3
ANNUAL FUEL OIL CONSUMPTION FOR FY84
FOR ABERDEEN AREA

<u>Building #</u>	<u>Tank Size</u>	<u>Annual Fuel Oil Consumption (Gals.)</u>
338	1-15,000	84,338.2
345A	1-100,000	220,032.9
345B	1-200,000	675,674.0
345C	1-70,000	759,972.1
455	1-10,000	68,344.8
507	1-10,000	101,009.1
525	1-15,000	119,629.4
629	1-10,000	25,087.4
1064	1-10,000	53,776.0
2312	1-10,000	67,994.2
2352	1-10,000	71,237.6
2377	1-10,000	29,826.0
2431	1-8,000	25,893.3
2457	1-8,000	31,582.6
2483	1-8,000	40,027.9
2502	1-15,000	153,740.7
2757	1-13,000	146,336.8
2915	1-10,000	163,726.7
3031	1-8,000	35,401.0
3062	2-10,000	147,150.2
3070A	1-25,000	113,020.7
3638	1-10,000	71,143.9
4119	1-15,000	151,377.2
4219	1-12,000	278,887.5
	1-15,000	
4304	1-10,000	59,515.7
4305	1-10,000	86,201.1
5033	1-10,000	113,650.6
5043	1-20,000	45,394.3
5206	1-10,000	105,739.5
5258	1-4,000	23,037.3
5413	1-2,000	10,815.2
5454	1-12,000	35,386.8
		<hr/>
		4,114,950.7

Source: Utilities Division, Mr. Larry Taylor

TABLE 1.4
ANNUAL FUEL OIL CONSUMPTION FOR FY84
FOR EDGEWOOD AREA

<u>Building #</u>	<u>Tank Size</u>	<u>Annual Fuel Oil Consumption (Gals.)</u>
E1574	3-8,000	126,693.7
E2100	1-20,000	141,549.7
E3148	2-15,000	7,081.5
E3302	1-60,000	328,895.1
E3312	2-50,000	2,812,006.0
	1-100,000	
E4160	2-14,000	323,766.2
E5126	2-100,000	3,958,560.9
E5828A	2-8,000	124,671.8
E6560	1-15,000	249,918.7
		<hr/>
		8,073,143.6

Source: Utilities Division, Mr. Larry Taylor

A list of Energy Conservation Opportunities (ECOs) to be investigated is contained in the Scope of Work. This list, along with previous energy conservation retrofit experience and the observations and data obtained from the site visits, provided a basis for a list of ECOs to be quantitatively analyzed. The opportunities involved are:

Boiler Plant

- o Boiler Economizer
- o Boiler Trim Controls
- o Combustion Air from Ceiling
- o Blowdown Controls
- o Installation of New Burners
- o Boiler Operation Optimization
- o Reduce Steam Pressure
- o Reduction in Make-up Water
- o Variable Speed I.D. Fans/Blowers
- o Air vs. Steam Atomization
- o Boiler Replacement Study

Chiller Plant

- o Chilled Water Temperature Reset
- o Condenser Water Temperature Reset
- o Small Chiller Application
- o Free Cooling
- o Automatic Variable Pitch Tower Fans
- o Variable Speed Tower Fans
- o Chiller Operation Optimization
- o Cycling Circulating Pumps
- o Condenser Water Treatment
- o Variable Speed Chilled Water Pumps
- o Chiller Replacement Study

Tables 1.5 and 1.6 show dot matrices for the Aberdeen and Edgewood areas which illustrate the applicable buildings for each ECO. Based on the energy calculations and financial analysis, (Volume II and III), a list of all projects having $SIR > 1$ is summarized in Tables 1.7 and 1.8 for the Aberdeen and Edgewood areas, respectively. Some of the ECOs are synergistic with others and totalling all the savings figures will result in double-dipping. To avoid this, only those ECOs that will not lead to double-dipping are recommended. For example, condenser water temperature reset and variable speed tower fan drives result in similar savings and only the one with the higher SIR value is recommended. Also, projects having SIR value close to unity and projects having payback of more than 10 years are not recommended.

Volume II of the report also highlights the state of maintenance at the two bases and includes operation and maintenance recommendations that should be followed.

Energy Engineering Analysis Program
 Location: APG, Aberdeen Area
 Equipment: Chiller Plants
 Updated: October 1985

Note: ● Denotes ECO's Applicable
 ▲ Building is Currently Served by a Temporary Chiller,
 Therefore no ECO's Are Recommended

Installation	ENERGY CONSERVATION OPPORTUNITIES											Remarks
	Reset Chilled Water Temperature	Reset Cond. Water Temp.	Small Chiller Application	Free Cooling	Auto. Variable	Variable Pitch Tower Fans	Optimization of Chiller Operation	Shutting Off/Cycling Operation	Condenser Water Treatment	Variable Speed CHW Pumps	Chiller Replacement Study	
Building 30	●	●			●				●	●	●	
Building 120		●							●		●	
Building 314	●	●			●				●	●		
Building 390	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
Building 392	●									●		
Building 393	●	●							●	●		
Building 394	●	●							●	●		
Building 400	●									●	●	
Building 2207	●	●			●				●	●		
Building 2401	●	●			●				●	●		
Building 2501		●		●	●				●	●		
Building 3144											●	
Building 3147	●									●		
Building 3148	●	●							●	●	●	
Building 3326	●	●							●			
Building 4305	●									●		

TABLE 1.5 ENERGY CONSERVATION OPPORTUNITIES MATRIX
 (ABERDEEN AREA)

Energy Engineering Analysis Program
 Location: APG, Aberdeen Area
 Equipment: Boiler Plants
 Updated: October 1985

ENERGY CONSERVATION OPPORTUNITIES

Note: ● Denotes ECO's Applicable
 ▲ Indicates Boiler is Either Obsolete or
 New Boiler is Being Installed (See Remarks)

Installation	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. I.D. Fans / Blowers	Air Vs. Steam Atomization	Boiler Replacement Study	Remarks
# 345 - Boiler No. 1	●	●	●	●	●	●	●	●			
Boiler No. 2	●	●	●	●	●	●	●	●			
Boiler No. 3	●	●	●	●	●	●	●	●			
# 525	▲	▲	▲	▲	▲	▲	▲	▲	▲		Three new boilers are being installed now.
# 507 - Boiler No. 1	▲	▲	▲	▲	▲	▲	▲	▲	▲		Obsolete unit.
Boiler No. 2	●	●	●								
Boiler No. 3	●	●	●								
# 2502 - Boiler No. 1	●	●	●			●					
Boiler No. 2	●	●	●			●					
Boiler No. 3	●	●	●			●					
# 3638 - Boiler No. 1	●	●	●								Status of building is unknown.
Boiler No. 2	●	●	●								
# 4119 - Boiler No. 1	●	●	●						●		
Boiler No. 2	●	●	●						●		
Boiler No. 3	●	●	●								
# 4219 - Boiler No. 1	●	●	●						●		
Boiler No. 2	●	●	●						●		
Boiler No. 3	●	●	●								
Boiler No. 4	●	●	●								
# 4305 - Boiler No. 1	●	●	●								
Boiler No. 2	●	●	●								
# 338 - Boiler No. 1	●	●	●						●		
Boiler No. 2	●	●	●						●		

TABLE 1.5 (CONTINUED)

Energy Engineering Analysis Program
 Location: APG, Aberdeen Area
 Equipment: Boiler Plants
 Updated: October 1985

**ENERGY
 CONSERVATION OPPORTUNITIES**

Note: ● Denotes ECO's Applicable
 ▲ Indicates Boiler is Either Obsolete
 or New Boiler is Being Installed (See Remarks)

Installation	ENERGY CONSERVATION OPPORTUNITIES											Remarks
	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	Reduction in Make-Up Water	V.S. ID Fans/Blowers	Air Vs. Steam Atomization	Boiler Replacement Study	
# 455 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									
# 629 - Boiler No. 1	●	●	●							●		
Boiler No. 2	●	●	●							●		May be replaced.
# 2377 - Boiler No. 1	●	●	●							●		
Boiler No. 2	●	●	●	●								
# 2312 - Boiler No. 1	●	●	●							●		
Boiler No. 2	●	●	●									
Boiler No. 3	●	●	●									
# 2483 - Boiler No. 1	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Obsolete unit is to be replaced.
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
# 2431 - Boiler No. 1	●	●	●	●								
Boiler No. 2	●	●	●									
# 2457 - Boiler No. 1	●	●	●	●								
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Obsolete unit is to be replaced.
# 3062 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									
# 3031 - Boiler No. 1	●	●	●									
# 5033 - Boiler No. 1	●	●	●							●		
Boiler No. 2	●	●	●	●								
# 5206 - Boiler No. 1	●	●	●							●		
Boiler No. 2	●	●	●	●								
# 1064 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									

TABLE 1.5 (CONTINUED)

Energy Engineering Analysis Program
 Location: APG, Aberdeen Area
 Equipment: Boiler Plants
 Updated: October 1985

Note: ● Denotes ECO's Applicable
 Indicates Boiler is Either Obsolete or
 New Boiler is Being Installed (See Remarks)

Installation	ENERGY CONSERVATION OPPORTUNITIES											Remarks
	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Reduce Operation Optimization	Reduction in Make-Up Water	V.S. I.D. Fans/Blowers	Air Vs. Steam Atomization	Boiler Replacement Study		
# 5258 - Boiler No. 1	●	●	●		●							
# 5454 - Boiler No. 1	●	●	●		●							
Boiler No. 2	●	●	●		●							
# 4304 - Boiler No. 1	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		New boiler being installed.
Boiler No. 2	●	●	●							●		
# 2352 - Boiler No. 1	●	●	●									
# 3070 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									
# 5043 - Boiler No. 1	●	●	●		●							
# 5413 - Boiler No. 1	●	●	●							●		
# 2757 - Boiler No. 1	●	●	●		●							
Boiler No. 2	●	●	●		●							
# 2915 - Boiler No. 1	●	●	●		●							
Boiler No. 2	●	●	●		●							

TABLE 1.5 (CONTINUED)

Energy Engineering Analysis Program
Location: APG, Edgewood Area
Equipment: Chiller Plants
Updated: October 1985

Note: • Denotes ECO's Applicable

Installation	ENERGY CONSERVATION OPPORTUNITIES											Remarks
	Chilled Water Temperature Reset	Cond. Water Temp. Reset	Small Chiller Application	Free Cooling	Auto. Variable	Variable Pitch Tower Fans	Chiller Speed Tower Fans	Cycling Operation Optimization	Condenser Water Treatment	Variable Speed CHW Pumps	Chiller Replacement Study	
Building E2100	•	•			•	•	•		•	•		
Building E3081	•	•				•	•		•	•		
Building E3100	•	•		•	•	•		•	•			
Building E3220	•	•			•	•		•	•			
Building E3244	•	•			•			•	•			
Building E3300	•	•	•	•	•	•		•	•			
Building E3580	•								•			
Building E5100	•	•		•	•	•		•	•			
Building E5101	•	•						•				
Building E5452	•	•						•				
Building E5951	•	•			•			•	•			

TABLE 1.6 ENERGY CONSERVATION OPPORTUNITIES MATRIX
(EDGEWOOD AREA)

Energy Engineering Analysis Program
Location: APG, Edgewood Area
Equipment: Boiler Plants
Updated: October 1985

Note: ● Denotes ECO's Applicable
▲ Indicates Boiler is Either Obsolete or
New Boiler is Being Installed (See Remarks)

Energy Engineering Analysis Program Location: APG, Edgewood Area Equipment: Boiler Plants Updated: October 1985			ENERGY CONSERVATION OPPORTUNITIES										
Installation			Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Reduce Operation Optimization	Reduce Steam Pressure	V.S. I.D. Fans/Blowers	Air Vs. Steam Atomization	Boiler Replacement Study	Remarks
Building E3148 - Boiler No. 1			●	●	●				●				Standby plant
Boiler No. 2			▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Boiler has been replaced.
Boiler No. 3			●	●	●				●				
Building E2100 - Boiler No. 1			●	●	●							●	Very old units.
Boiler No. 2			●	●	●								
Boiler No. 3			●	●	●								
Building E1574 - Boiler No. 1			●	●	●								
Boiler No. 2			●	●	●								
Boiler No. 3			●	●	●								
Building E3312 - Boiler No. 1			●	●	●		●	●					
Boiler No. 2			●	●	●			●	●				
Boiler No. 3			●	●	●			●	●				
Boiler No. 4			●	●	●		●	●		●	●		Very old units.
Boiler No. 5			●	●	●		●	●		●	●		Very old units.
Building E4160 - Boiler No. 1			●	●	●								
Boiler No. 2			●	●	●								
Boiler No. 3			●	●	●								
Building E5126 - Boiler No. 1			●	●	●		●	●	●		●		Very old units.
Boiler No. 2			●	●	●		●	●	●		●		Very old units.
Boiler No. 3			●	●	●		●	●	●		●		Very old units.
Boiler No. 4			●	●	●		●	●	●		●		Very old units.
Boiler No. 5			●	●	●		●	●	●		●		Very old units.
Boiler No. 6			▲	▲	▲	▲	▲	▲	▲	▲	▲		New unit being installed.

TABLE 1.6 (CONTINUED)

Energy Engineering Analysis Program
Location: APG, Edgewood Area
Equipment: Boiler Plants
Updated: October 1985

Note: ● Denotes ECO's Applicable
▲ Indicates Boiler is Either Obsolete or
New Boiler is Being Installed (See Remarks)

ENERGY CONSERVATION OPPORTUNITIES												
Installation	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. I.D. Fans/Blowers	Air Vs. Steam Advancement	Boiler Replacement Study	Remarks	
Building E3302 - Boiler No. 1	●	●	●									
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	New unit being installed	
Building E5828 - Boiler No. 1	●	●	●	●								
Boiler No. 2	●	●	●	●								
Building E6560 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									

TABLE 1.6 (CONTINUED)

SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1 (ABERDEEN AREA)

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil						
	-----		-----						
	KWH	MBTU	MBTU						
CHILLED WATER TEMPERATURE RESET									
314	18285	212.1	-	-	1097	979	5926	1.16	NOTE 1
394	18277	212.0	-	-	1097	979	5926	1.54	NOTE 2
VARIABLE SPEED DRIVE ON CONDENSING UNITS									
4305	34930	405.2	-	-	2095	1928	16743	1.07	NR
VARIABLE SPEED CHILLED WATER PUMPS									
314	76220	884.2	-	-	4573	4353	21957	1.39	RECOM
394	22510	261.1	-	-	1350	1253	9769	1.19	NOTE 2

NOTE 1 : This project is not recommended since it is synergistic with the variable speed CHW pump ECO and greater savings could be achieved by the latter.

NOTE 2: New unit has been installed recently and therefore project is not recommended.

TABLE 1.7 CONTINUED)

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SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1 (ABERDEEN AREA)

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil						
	-----		-----						
	KWH	MBTU	MBTU						
BOILER ECONOMIZER									
345 - # 1, 2 & 3	-	-	-	16329	122302	119574	272767	3.67	RECOM
2502 -#1 & 2	-	-	-	965	7228	7000	44670	1.02	NR
2502 -#3	-	-	-	271.3	2032	1887	14470	1.32	RECOM
4219 -#4	-	-	-	291.8	2186	2041	14470	2.24	RECOM
5206 -#2	-	-	-	559.8	4193	3943	24986	1.33	RECOM
2352 -#1	-	-	-	245.9	1842	1683	15903	1.76	RECOM
2915 -#1	-	-	-	751.0	5625	5379	24626	2.02	RECOM
2915 -#2	-	-	-	725.0	5430	5184	24626	1.94	RECOM
BOILER TRIM CONTROLS									
345 -#1,2,3	-	-	-	11373.2	85185	82898	57176	12.14	RECOM
2502 -# 1	-	-	-	1744.4	13066	12303	19058	4.35	RECOM
-# 2	-	-	-	1212.9	9084	8322	19058	2.95	RECOM
2352 -# 1	-	-	-	297.5	2228	1466	19058	1.46	RECOM
2915 -# 2	-	-	-	1939.9	14530	13767	19058	6.68	RECOM

TABLE 1.7 (CONTINUED)

pg 3 of 3

SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1 (ABERDEEN AREA)

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity	Fuel Oil	MBTU	MBTU					
	KWH								
COMBUSTION AIR FROM CEILING									
345 -# 1,2 & 3	-	-	-	1109.6	8311	7973	56324	1.2	NR <i>7.1</i>
2502 -# 1 & 2	-	-	-	234.9	1759	1650	10977	1.01	NR <i>6.7</i>
2915 -# 1 & 2	-	-	-	198.5	1487	1366	12125	1.05	NR <i>8.9</i>
BOILER BLOWDOWN									
345 -# 1,2,3	-	-	-	1121.0	8396	8238	15835	4.35	RECOM
INSTALLATION OF NEW BURNER									
2915 -# 1 & 2	-	-	-	3705.4	27754	28608	85378	3.05	RECOM
TOTALS FOR RECOMMENDED PROJECTS									
	76,220	884.2		40,568	308,426	299,646	648,426		
				<i>2912</i>		<i>19,917</i>	<i>148,839</i>		

NOTE : NR indicates projects not recommended since SIR value is close to unity.

TABLE 1.8

Pg 1 of 4

SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1 (EDGEWOOD AREA)

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil						
	KWH	MBTU		MBTU					
CHILLED WATER TEMPERATURE RESET									
E2100	32699	379.3	-	-	1864	1726	6879	2.23	Note 1
E3081	32960	382.3	-	-	1879	1741	6879	2.35	Note 1
E3100	30937	358.9	-	-	1764	1626	6879	1.66	Note 1
E3220	23077	267.7	-	-	1315	1178	6879	1.59	Note 1
E3300	61875	717.8	-	-	3527	3389	6879	3.46	Recom
E5100	33348	386.8	-	-	1901	1763	6879	1.80	Note 1
CONDENSER WATER TEMPERATURE RESET									
E2100	25470	295.5	-	-	1452	1302	7516	1.54	Note 2
E3081	26040	302.1	-	-	1484	1334	7516	1.65	Note 2
E3220	77005	893.3	-	-	4389	4239	7516	5.24	RECOM
E3244	46770	542.5	-	-	2666	2536	6483	3.63	RECOM
E3300	42600	494.2	-	-	2428	2278	7516	2.13	Note 2
E5100	26720	310	-	-	1523	1373	7516	1.28	RECOM
VARIABLE SPEED TOWER FAN DRIVES									
E2100	72750	843.9	-	-	4147	3936	21099	1.66	RECOM
E3081	64540	748.7	-	-	3679	3468	21099	1.53	RECOM
E3100	100970	1171.3	-	-	5756	5514	24179	1.60	RECOM
E3220	40335	467.9	-	-	2299	2187	11259	1.80	NOTE 3
E3244	20195	234.3	-	-	1151	1054	9764	1.00	NOTE 3
E3300	161610	1874.7	-	-	9212	8934	27837	2.25	RECOM
E5100	60640	703.4	-	-	3457	3246	21099	1.08	NOTE 3
E5951	36370	421.9	-	-	2073	1968	10547	1.31	RECOM

TABLE 1.8 (CONTINUED)

pg 2 of 4

SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil						
	-----		-----						
	KWH	MBTU	MBTU						
VARIABLE SPEED CHILLED WATER PUMPS									
E2100	72750	843.9	-	-	4147	4008	13919	2.56	RECOM
E3081	85940	996.9	-	-	4899	4689	20933	2.08	RECOM
E3100	101240	1174.4	-	-	5771	5540	23091	1.68	RECOM
E3220	121280	1406.8	-	-	6913	6648	26543	2.33	RECOM
E3300	161340	1871.5	-	-	9197	8918	27837	2.25	Note 4
E5100	121270	1406.7	-	-	6913	6678	23452	2.00	RECOM

TOTALS FOR
RECOMMENDED
PROJECTS

1,250,555.0	14,506.5	-	-	71,286.0	68,449.0	262,051.0
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NOTE 1: This project is not recommended since it is synergistic with the V. S. CHW pump ECO and greater savings could be achieved by the latter.

NOTE 2: This project is not recommended since it is synergistic with the V. S. Cond fan ECO and greater savings could be achieved by the latter.

NOTE 3: This project is not recommended since it is synergistic with the condenser reset ECO and greater savings could be achieved by the latter.

Note: This project is not recommended since it is synergistic with the chilled water temperature reset ECO and higher SIR value could be achieved by the latter.

TABLE 1.8 (CONTINUED)

pg 3 of 4

SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1 (EDGEWOOD AREA)

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil						
	KWH	MBTU		MBTU					

BOILER ECONOMIZER									
E3312 -#1	-	-	-	2123.3	15904	15562	34194	4.90	RECOM
-#2	-	-	-	1274.0	9542	9029	51294	2.18	RECOM
-#3	-	-	-	1839.1	13775	13262	51294	3.19	RECOM
E4160 -#1	-	-	-	384.4	2879	2675	20375	1.63	RECOM
-#2	-	-	-	594.1	4450	4246	20375	2.57	RECOM
-#3	-	-	-	262.8	1968	1765	20375	1.09	NR
E5828 -#1	-	-	-	425.4	3186	2999	18746	2.64	RECOM
-#2	-	-	-	425.4	3186	2999	18746	2.10	RECOM
E6560 -#1	-	-	-	283.1	2120	1862	25869	1.07	NR
-#2	-	-	-	293.6	2199	1940	25869	1.11	NR
BOILER TRIM CONTROLS									
E2100 -#3	-	-	-	523.0	3917	3155	19058	2.01	RECOM
E3312 -#1	-	-	-	3058.8	22910	22148	19058	12.55	RECOM
-#2	-	-	-	1150.6	8618	7855	19058	5.15	RECOM
-#3	-	-	-	776.9	5819	5056	19058	3.36	RECOM
E4160 -#1	-	-	-	674.9	5055	4293	19058	2.87	RECOM
-#2	-	-	-	439.9	3295	2533	19058	1.74	RECOM
E3302 -#1	-	-	-	441.6	3307	2545	19058	2.37	RECOM
E5828 -#1	-	-	-	237.2	1776	1014	19058	1.07	NR
-#2	-	-	-	447.5	3352	2590	19058	1.89	RECOM

TABLE 1.8 (CONTINUED)

SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR > 1

BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil						
	KWH	MBTU	MBTU						
COMBUSTION AIR FROM CEILING									
E3312 -#1	-		203.3	1523	1445	7767	2.02	RECOM	
-#2	-		178.4	1336	1254	8269	1.88	RECOM	
-#3	-		220.9	1655	1572	8269	2.35	RECOM	
E4160 -#1,2,3	-		204.7	1533	1380	15336	1.13	NR	11
E3302 -#1	-		183.9	1377	1300	7766	2.76	RECOM	
E5828 -#1	-		44.6	334	287	4664	1.05	NR	16
INSTALLATION OF NEW BURNER EQUIPMENT									
E3312 -#1	-		2794.0	20927	22193	126632	1.86	RECOM	
SMALL BOILER APPLICATION									
E3302	-		4400.0	33000	28878	203911	2.75	RECOM	
REDUCTION IN MAKEUP WATER QUANTITY									
E5126	-29120		-337.8	98800	97176	646900	2.79	currently programmed	
BOILER REPLACEMENT STUDY									
E5126 -#1 TO 5	-		70343.3	526871	545077	1,820,569	5.46	RECOM	
TOTALS FOR RECOMMENDED PROJECTS									
			1327		8218	111771			
(29,120.0)			(337.8)	92,902.7	695,884.0	702,666.0	2,550,671.0		252,500 5.9

1.4 RECOMMENDED PROJECTS

A list of all projects recommended is shown in Table 1.9.

The projects recommended are grouped into five PECIP projects and one locally funded project. These are:

PECIP #1: Boiler Trim Controls

PECIP #2: Boiler Economizer

PECIP #3: New Boiler Installation (E3302, E5126)

PECIP #4: Miscellaneous Boiler Projects
(Boiler Blowdown, Installation of New Burner)

PECIP #5: Miscellaneous Chiller Projects

Locally funded project: Combustion air from ceiling

Each of the above five PECIP projects has total investment exceeding \$100,000 and a combined payback period of less than four years. The only project not meeting PECIP or ECIP guidelines is: Combustion Air from the Ceiling. This project has SIR value greater than one, but payback of more than four years and total investment below \$100,000. As suggested by the base, this project should be locally funded and no documentation is required.

The total savings resulting from these projects are:

o Total Annual Energy Savings, Electricity	= 1,326,775 KWH
	or
	15,391 MBTU
Fuel Oil	= 133,173 MBTU
● Total Annual Source Energy Savings	= 148,564 MBTU
● Total Investment Required	= \$3,442,090
● Total Annual Energy Cost Savings	= \$1,073,367
● Annual Dollar Savings	= \$1,069,295
● Simple Payback	= 3.2 years
● Annual Base-wide Energy Cost	= \$22,457,600
● Percent Energy Cost Savings	= 4.8%

The five PECIP projects are separately documented and bound. The proposed operational date for these projects is October, 1988.

TABLE 1.9

PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		Electricity		Fuel Oil						
		KWH	MBTU	MBTU	MBTU					
PECIP PROJECT # 1 :										
BLR TRIM CONTROLS	E 3312 -#1	-	-	-	3,059	22,910	22,148	19,058	0.9	12.55
	345 -#1,2,3	-	-	-	11,373	85,185	82,898	57,176	0.7	12.14
	2915 -#2	-	-	-	1,940	14,530	13,767	19,058	1.4	6.68
	E 3312 -#2	-	-	-	1,151	8,618	7,855	19,058	2.4	5.15
	2502 -#1	-	-	-	1,744	13,066	12,303	19,058	1.5	4.35
	E 3312 -#3	-	-	-	777	5,819	5,056	19,058	3.8	3.36
	2502 -#2	-	-	-	1,213	9,084	8,322	19,058	2.3	2.95
	E 4160 -#1	-	-	-	675	5,055	4,293	19,058	4.4	2.87
	E 3302 -#1	-	-	-	442	3,307	2,545	19,058	7.5	2.37
	E 2100 -#3	-	-	-	523	3,917	3,155	19,058	6.0	2.01
	E 5828 -#2	-	-	-	448	3,352	2,590	19,058	7.4	1.89
	E 4160 -#2	-	-	-	440	3,295	2,533	19,058	7.5	1.74
TOTAL		-	-	-	23,784	178,138	167,465	266,814	1.6	

TABLE 1.9(CONT'D)

PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		Electricity		Fuel Oil						
		KWH	MBTU	MBTU	MBTU					
PECIP PROJECT # 2 :										
BOILER ECONOMIZER	E 3312 -#1	-	-	-	2,123	15,904	15,562	34,194	2.2	4.90
	345 -#1,2&3	-	-	-	16,329	122,302	119,574	272,767	2.3	3.67
	E 3312 -#3	-	-	-	1,839	13,775	13,262	51,294	3.9	3.19
	E 5828 -#1	-	-	-	425	3,186	2,999	18,746	6.3	2.64
	E 4160 -#2	-	-	-	594	4,450	4,246	20,375	4.8	2.57
	4219 -#4	-	-	-	292	2,186	2,041	14,470	7.1	2.24
	E 3312 -#2	-	-	-	1,274	9,542	9,029	51,294	5.7	2.18
	E 5828 -#2	-	-	-	425	3,186	2,999	18,746	6.3	2.10
	2915 -#1	-	-	-	751	5,625	5,379	24,626	4.6	2.02
	-#2	-	-	-	725	5,430	5,184	24,626	4.8	1.94
	2352 -#1	-	-	-	246	1,842	1,683	15,903	9.4	1.76
	E 4160 -#1	-	-	-	384	2,879	2,675	20,375	7.6	1.63
	5206 -#2	-	-	-	560	4,193	3,943	24,986	6.3	1.33
	2502 -#3	-	-	-	271	2,032	1,887	14,470	7.7	1.32
TOTAL		-	-	-	26,240	196,532	190,463	606,872	3.2	

TABLE 1.9(CONT'D)

PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		Electricity		Fuel Oil						
		KWH	MBTU	MBTU	MBTU					
PECIP PROJECT # 3 :										
BLR REPLACEMENT	E5126 - # 1-5	-	-	-	70,343	526,871	545,077	1,820,569	3.3	5.46
SMALL BOILER APPL	E 3302	-	-	-	4,400	33,000	28,878	203,911	7.1	2.75
TOTALS		-	-	-	74,743	559,871	573,955	2,024,480	3.5	
PECIP PROJECT # 4 :										
BOILER BLOWDOWN	345 -#1,2&3	-	-	-	1,121	8,396	8,238	15,835	1.9	4.35
NEW BURNER	2915 -#1&2 E 3312 -#1	-	-	-	3,705 2,794	27,754 20,927	28,608 22,193	85,378 126,632	3.0 5.7	3.05 1.86
TOTALS		-	-	-	7,620	57,077	59,039	227,845	3.9	

TABLE 1.9 (cont'd)

PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS				ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		Electricity		Fuel Oil						
		KWH	MBTU	MBTU	MBTU					
PECIP PROJECT # 5 :										
CDW RESET	E 3220	77,005	893	-	-	4,389	4,239	7,516	1.8	5.24
	E 3244	46,770	543	-	-	2,666	2,536	6,483	2.6	3.63
	E 5100	26,720	310	-	-	1,523	1,373	7,516	5.5	1.28
CHW RESET	E 3300	61,875	718	-	-	3,527	3,389	6,879	2.0	3.50
V.S. TOWER FAN	E 3300	161,610	1,875	-	-	9,212	8,934	27,837	3.1	2.25
	E 2100	72,750	844	-	-	4,147	3,936	21,099	5.4	1.66
	E 3100	100,970	1,171	-	-	5,756	5,514	24,179	4.4	1.60
	E 3081	64,540	749	-	-	3,679	3,468	21,099	6.1	1.53
	E 5951	36,370	422	-	-	2,073	1,968	10,547	5.4	1.31
V.S. CHW PUMPS	E 2100	72,750	844	-	-	4,147	4,008	13,919	3.5	2.56
	E 3220	121,280	1,407	-	-	6,913	6,648	26,543	4.0	2.33
	E 3081	85,940	997	-	-	4,899	4,689	20,933	4.5	2.08
	E 5100	121,270	1,407	-	-	6,913	6,678	23,452	3.5	2.00
	E 3100	101,240	1,174	-	-	5,771	5,540	23,091	4.2	1.68
	314	76,220	884	-	-	4,573	4,353	21,957	5.0	1.39
		1,227,310	14,237	0	0	70,188	67,273	263,050	3.9	

TABLE 1.9 (CONTD)

PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS				FUEL OIL MBTU	ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		Electricity		MBTU							
		KWH	MBTU	MBTU	MBTU						
LOCAL FUNDING :											
COMB AIR FROM CLG	E 3302 -#1	-	-	-	184	1,377	1,300	7,766	6.0	2.76	
	E 3312 -#3	-	-	-	221	1,655	1,572	8,269	5.3	2.35	
	E 3312 -#1	-	-	-	203	1,523	1,445	7,767	5.4	2.02	
	E 3312 -#2	-	-	-	178	1,336	1,254	8,269	6.6	1.88	
TOTALS		-	-	-	787	5,891	5,571	32,071	5.8		